

PROCEEDINGS  
OF THE  
LINNEAN SOCIETY  
OF  
NEW SOUTH WALES.

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WEDNESDAY, MARCH 27TH, 1912.

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The Thirty-seventh Annual General Meeting, and the Ordinary Monthly Meeting, were held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, March 27th, 1912.

ANNUAL GENERAL MEETING.

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Mr. W. W. Froggatt, F.L.S. President, in the Chair.

The Minutes of the preceding Annual General Meeting (March 29th, 1911) were read and confirmed.

The President delivered the Annual Address.

PRESIDENTIAL ADDRESS.

Though no special anniversaries or extraneous events demanded attention during the past year, I think I may say that the Society found, in its ordinary legitimate work, enough to keep it busily and enthusiastically occupied.

Thirty-four papers, covering a wide range of subjects, were communicated at the Monthly Meetings, while there was no falling off in the number of exhibits of interest. The majority of the papers have been published and distributed; the remaining eight are printed off, and will be ready for issue on completion of the index. The Society's new printers, Messrs. Pepperday & Co., have shown a commendable desire to give satisfaction. The issues of the Parts of the Proceedings have been slightly delayed, as was to be expected; but now that the printing-room staff have



had a year's experience of the Society's particular class of work, and have almost completed one volume, we may hope to see the Parts issued as heretofore, without avoidable delay.

Twenty-three individuals were elected into the Society, but four of these have not accepted their obligations, so that the total increase has been nineteen. The only decrease, happily, has been one, by resignation. A new list of Members will be issued shortly.

The hour of holding the Monthly Meetings during the winter-months was altered from 8 o'clock to 7.30 p.m.; and as the change has given satisfaction, it is proposed to continue this arrangement during the autumn and winter.

The Hon. Treasurer will presently announce to you that the amount of the Fellowships Capital Fund has been increased to £40,000, giving promise that the Council may shortly be able to consider the possibility of appointing a fourth Linnean Macleay Fellow, as contemplated by Sir William. But, in the meantime, during the present year, the Society's most important investment, comprising the bulk of its endowment funds, matures, and the money will need to be re-invested. Nowadays so many unexpected contingencies affecting investments, especially in connection with new legislation, are likely to happen in the course of five years, that the prospect of obtaining a thoroughly satisfactory new investment naturally causes the Council some anxiety. By the terms of the trust, the Society's investments are necessarily of a restricted character. Two out of the three classes of securities available, at present, yield no higher return than  $3\frac{3}{4}\%$ ; so that unless the funds can be satisfactorily re-invested on mortgage, yielding not less than  $4\%$ , we may shortly be faced with the problem of a diminution of income of some sort. The Hon. Treasurer, therefore, feels called upon to counsel reasonable economy, in every way, in the meantime.

In consequence of the increased cost of printing, both letter-press and illustrations, under our new arrangements, at the beginning of last Session, the Council reluctantly decided that it was advisable to reduce the size of the annual volume by 100 pages or the equivalent thereof, to balance the increased cost.

The Royal Society of London, with large private means, and an annual grant of £1,000 from the Government towards the cost of publishing its Proceedings, Transactions, and Reports, finds it necessary to make a standing appeal to authors "to see that their papers are put in as concise a form as possible," since "Delay in decisions regarding publication, as well as subsequent trouble to authors, is often caused by diffuseness or prolixity." The notice embodying this appeal appears on the inside of the cover of each No. of the Proceedings, and the request is made because "The Council have had under consideration the rapid increase of the Society's expenditure on publications," and "In view of the necessity for economy." Our need for economy arises from the fact that some of our investments are yielding a lower return than they used to, that the cost of printing is higher than it has ever been before in the Society's experience, and because, contrary to Sir William Macleay's expectations, the Society's general fund has had to bear the burden of the administration of its Research Funds; so that if there should be any further diminution of income due to less remunerative investments, the Council may have to make a special appeal to the authors of papers, for coöperation in keeping down expenses.

The Macleay Bacteriologist has continued his investigations of the problem of soil-fertility. No. 2 of the series has been issued; Nos. 3 and 4 will appear in the forthcoming Part of the Proceedings; while No. 5, dealing with the action of fat-solvents upon sewage-sick soils, is ready, and will be communicated to the Society as soon as possible. Dr. Greig-Smith considers that his later investigations amply confirm the views expressed in his earlier papers, namely, that the action of heat and of volatile disinfectants in increasing soil-fertility is not entirely due to the destruction of phagocytic protozoa, but that bacteriotoxins and the presence of agri-cere are also factors of importance. The function of the agri-cere has been confirmed by using soils in which the protozoa had been destroyed by a moderate heat. The volatile disinfectants then showed their activity as fat-solvents by inducing a greater proliferation of bacteria. Furthermore, the

deposition of the agricerine by the solvent is greatest in the upper layers of the soil, and in these layers the bacterial increase is less than in the lower defatted strata. Other cognate matters were investigated, and it was shown that heavy rains wash the soil-toxins into the subsoil.

The number of nodule-forming bacteria in the soil was also investigated. That the nodule-organism of leguminous plants is capable of fixing atmospheric nitrogen while free in the soil, is generally admitted, but the fixation is chiefly credited to the *Azotobacter* group of bacteria. This is mainly because it is presumed that the normal place for the anabolic changes effected by the nodule-former is in the nodular tissue of leguminous plants. They were not thought to be very numerous in soil, and the only investigations that had been made revealed but a few hundreds. By a special method of cultivation, Dr. Greig-Smith has shown that they are very numerous in agricultural soils, ranging up to two or three millions per gram. This considerably modifies our ideas regarding the capacity of the organism for fixing free nitrogen. From their numbers in soils, there is every probability that the nodule-former is responsible for the major part of the gain of combined nitrogen, which the soil continually receives. The subject of the relationship of this microbe to the plant is interesting and is at present under investigation. The numbers, that are in soils, vary according to the soil, the better soils containing more, the poorer less; and it is possible, by estimating their number, to compare the fertility of two or more soils. The comparatively large number of these bacteria in soils has been recently (November 11th, 1911) confirmed by Millard, who, in one case, found two and one-half millions in a gram of soil.

One who works with soil-bacteria knows that many of them are gum-formers, and, as their typical faculty is pronounced when they are obtained, it would appear that bacterial gums are to be found in soils. The matter was tested, and evidence of the presence of these substances in soil was shown.



Dr. J. M. Petrie, Linnean Macleay Fellow in Biochemistry, has concluded his investigation of the rôle of nitrogen in plant-metabolism; and the results of his later researches, embodied in Parts iii.-v. of the series, were published in Part i., of last year's Proceedings. His work upon the alkaloids of *Solandra*, *Duboisia*, and several other promising plants, is being continued, but has been somewhat interrupted by the lack of adequate material. An important paper on the chemistry of Sassafras (*Doryphora sassafras* Endl.) has been completed, and will be communicated to the Society at the Meeting in April. Considerable progress has also been made in a systematic survey of indigenous and other plants for hydrocyanic acid compounds. This investigation promises to be one of great interest and importance. Perhaps the most important discovery so far is that of the presence of hydrocyanic acid in a blue couch-grass (*Cynodon incompletus* Nees), originally introduced from South Africa, but which has now spread over a considerable area in the northern districts of the State. This discovery explains the otherwise mysterious fatalities among stock which have been attracting serious attention of late. I have much pleasure in announcing to you that the Council has reappointed Dr. Petrie to a Fellowship for another year from 1st proximo; and in offering him the Society's congratulations on the important and promising lines of work which he is opening up.

For special reasons, detailed in the last Presidential Address, two Fellowships remained vacant during the year. Three candidates offered themselves in response to the Council's invitation for the period 1912-13; and I have now great pleasure in making the first public announcement of the election of Mr. Edward F. Hallmann, B.Sc., and of Mr. Arthur B. Walkom, B.Sc., to Linnean Macleay Fellowships, their appointments dating from 1st proximo.

Mr. Hallmann took his degree in Science at the Sydney University in 1906; was subsequently Science Master, Sydney Boys' High School, for three and one-half years; and for nearly three

years, up to the time of his appointment as Linnean Macleay Fellow, Invertebrate Zoologist on the staff of the Australian Museum. Mr. Hallmann comes to the Society highly recommended by his instructors, senior colleagues at different times, and others; and may confidently be trusted to justify the high expectations which the Council has been led to take of his qualifications. He has selected Zoology as his branch of study; and will devote his attention particularly to further elucidation of the characters of the Monaxonellid Sponges, as preliminary to the consideration of the question of a more satisfactory natural system of classification of the Monaxonida. Mr. Hallmann has been engaged for some time upon a voluminous report on the Monaxonellida dredged during the cruise of the Federal Trawler, "Endeavour," off the coasts of Australia, prepared for the Trustees of the Australian Museum, and now in course of publication.

Mr. A. B. Walkom, graduated in 1910, and comes to us with an excellent University record, having gained High Distinction in Geology each year; First Class Honours and Medal in Geology and Mineralogy, and Second Class Honours in Chemistry at graduation. He has also held the position of Junior Demonstrator in Geology, under Professor David for two years. Mr. Walkom has selected Geology as his branch of study; and, as a Linnean Fellow, will now give his attention to a detailed study of the stratigraphical relations of the Permo-Carboniferous areas of Australia and Tasmania, with special reference to the palæogeography of that period. He has contributed a paper entitled "Report on the Pyroxene-Granulites collected by the British Antarctic Expedition, 1907-09," to the Scientific Memoirs of the Expedition, now in course of publication; and has collaborated with Mr. W. R. Browne, B.Sc., in the preparation of a paper on "The Geology of the Eruptive and associated Rocks of Pokolbin, N.S.W.," which has been communicated to the Royal Society of New South Wales. Mr. Walkom comes to his new duties with the highest recommendations from the teaching staff of the Geological Department of the University, and well equipped for the work which he is about to undertake. I have very much pleasure in offering to him, and to Mr. Hallmann, the very hearty

congratulations of the Society on their appointment as Fellows, and of assuring them of a genuine and encouraging interest in their projected work.

At the Meeting in May, the Society was asked to co-operate with the Fauna and Flora Protection Committee of South Australia, and the Royal Society of South Australia, in an effort to have a portion of Kangaroo Island, comprising an area of 300 square miles, to be known as Flinders Chase, permanently reserved, and vested in trustees. The Meeting cordially responded to the invitation, and appointed Dr. R. Pulleine, of Adelaide, to represent the Society on a deputation to the Treasurer and Commissioner of Crown Lands, which had been arranged. The deputation, which comprised representatives of twenty-seven Australian Societies and twelve Corporations and District Councils in the State, and was received by the Hon. C. Vaughan, on June 13th, met with very courteous and sympathetic treatment from the Minister, who promised to make personal inspection of the area for which reservation was asked; and also that he would make a recommendation on the subject, to the Cabinet. Dr. Pulleine kindly sent us full press reports of the interview, which were brought under the notice of Members; but a permanent record of this, and other efforts to secure National Parks in South Australia, for the protection of the fauna and flora, will be found in a paper by Mr. S. Dixon in the last volume of the Transactions and Proceedings of the Royal Society of South Australia (xxxv., 1911, p.248).

The death of the veteran English botanist, Sir Joseph Dalton Hooker, on 10th December, 1911, in the ninety-fifth year of his age, is an event which cannot be passed over in silence on the present occasion. I do not propose to speak at length of Sir Joseph's varied and extensive travels, of his long official connection with Kew Gardens in association with, or in succession to, his distinguished father; of his pre-eminence among British botanists, of his many and important contributions to botanical science, or of the details of his prolonged and memorable career, so rich in experience and in service, and crowned with honours. But I should like to remind you

of his fruitful labours in this part of the world at the outset of his scientific career, more than seventy years ago, and of the important additions to a knowledge of the flora of Tasmania and Australia, to which these mainly contributed. Upon the completion of his medical studies, Sir Joseph, then Dr. Hooker, entered the Royal Navy, and, as Assistant-Surgeon and Naturalist, he was gazetted to the "Erebus," one of the two ships which left England, in command of Captain Sir James Clark Ross, in September, 1839, under the auspices of the British Government, "for the purpose of investigating the phænomena of Terrestrial Magnetism in various remote countries, and for prosecuting Maritime Geographical Discovery in the high southern latitudes." The annals of this justly celebrated expedition, which has been described as "one of the most brilliant and famous of all voyages of discovery that have ever been made," are both extensive, and very complete. Captain Ross's programme, as carried out, comprised three successful attempts to reach high southern latitudes, during three successive seasons, starting from a different base each time—first from Hobart, next from New Zealand, and then from the Falkland Islands. The route selected by the Commander, in carrying out his plans, gave the botanist the opportunity of collecting and observing the floras of the most important insular areas contiguous to Antarctica. Three months in 1840, and again three months in the following year, were spent in collecting Tasmanian plants. On the way from Tasmania to New Zealand, the "Erebus" and "Terror" called at Port Jackson, remaining from 14th July to 5th August, 1841, and, in Dr. Hooker's own words, "a considerable herbarium was formed, chiefly in the neighbourhood of Sydney and Botany Bay." The botanical results of the expedition eventually took shape as "The Botany of the Antarctic Voyage of H.M. Discovery Ships 'Erebus' and 'Terror,' 1839-43, under command of Sir James Ross, with over 500 coloured plates, in six volumes, royal quarto, 1844-60." This fine work comprises three Sections, of which No.

iii., "Flora Tasmaniae, with an Introductory Essay on the Flora of Australasia," issued in 1853-60, most directly concerns Australian botanists.

This great monograph is still indispensable for reference, because of the beautiful illustrations, and also because it takes account of the more important lower Cryptogams. The Introductory Essay, a philosophical treatise dealing with the characters and relations of the Australian flora, and cognate matters, is still a classic, which is not likely to be superseded. On the completion of his extensive and laborious study of this flora, Mr. Bentham, in the preface to the last volume of the *Flora Australiensis* (1878), says—"With regard to Geographical Distribution, I can only repeat that recent discoveries and the additional data collected have generally confirmed the principles laid down by J. D. Hooker in the admirable Essay prefixed to his 'Flora Tasmaniae,' and that it is only in minor details that corrections or additions have now to be made to it." Thus we cannot forget that Sir Joseph Hooker was the last in the succession of the great English botanists and collectors, who visited Australia, and whose contributions to a knowledge of the flora were published before the first volume of Mr. Bentham's "*Flora Australiensis*," made its appearance (1863).

If I make no reference to the important events which have transpired of late, or are now transpiring in Antarctica, it is because, not being a geographer, I am unable to add anything to the newspaper reports, supplemented by Professor David's illuminating commentaries

In the interval since Mr. Lucas delivered his admirable Presidential Address "On the Relations of Science and Government," just four years ago, we have had some gratifying evidence of the recognition by Australian Governments, and especially by the Federal Government, that Science is the natural ally of the Government, and can be wisely and advantageously utilised. Last year, by arrangement with the Universities of Melbourne and Sydney, Professor Baldwin Spencer, Professor Gilruth, and



Dr. Woolnough, accompanied also by Dr. Breinl, of the Tropical Institute of Medicine at Townsville, were enabled to visit the Northern Territory with the object of studying, as far as time would permit, some of the difficult problems which present themselves in connection with the settlement and development of that vast but remote portion of the Continent. One result has been the reappointment, for the year 1912, of Professor Spencer, as Special Commissioner in connection with the Protection of the Aborigines; and Professor Gilruth has severed his connection with the University of Melbourne, to enter upon the duties of Administrator of the Territory for a period of five years. Now this alliance of Government with Science in the case of the Northern Territory, is a very interesting and important experiment. For if trained scientific men with capacity for organisation, with no axes to grind, and with a sympathetic Federal Government behind them, cannot find some way of dealing satisfactorily with the difficult problems in connection with the Northern Territory, with which they are called upon to deal, then the problems must be well-nigh insoluble.

Another instance is afforded by the assignment of Mr. McAlpine, Vegetable Pathologist to the Victorian Department of Agriculture, to the Federal Government, for a period of two years, for the purpose of making a thorough study of the disease known as the Bitter Pit of Apples, under local conditions. Though not unknown in Europe and America, the disease is particularly prevalent in South Africa and Australia. The so-called pits, appearing as rust-coloured patches when an infected apple is pared, are found to be free from bacteria and other organisms; and their occurrence, therefore, has been attributed to physiological causes. By way of a preliminary study of the question, Mr. McAlpine communicated two papers on the fibro-vascular system of the normal apple, and of the normal pear (pome), to the Society, and they will appear in the forthcoming Part of the Proceedings.

A third instance is afforded by the visit of Mr. J. E. Carne, of the Department of Mines, Sydney, to New Guinea, to report on the deposits of Tertiary coal which have been discovered in recent years. Seeing that the Commonwealth Scientific Departments



are necessarily limited in number at present, it is very gratifying to note the readiness of the State Governments and of the Universities to lend their experienced scientific officers to the Federal Government, for the purpose of investigating important matters which concern more than a single State.

The Prickly Pear problem, too, just now is claiming the joint consideration of the Governments of New South Wales and Queensland; and the appointment of a Commission, comprising an entomologist and a pathologist, to investigate the question, is proposed. It is true that this savours somewhat of calling in the doctor when the complaint has become almost chronic, whereas, at an earlier stage, the matter was not beyond easy control. But the existing Governments cannot be held responsible for the neglect of those who had their opportunity, and neglected it. The noteworthy point is the steadily increasing recognition of the importance of an alliance with Science, by the Governments of Australia.

In his stimulating Presidential Address of 1908, to which I have already made reference, Mr. A. H. S. Lucas pointed out in a general way how Man has taken charge of the geographical distribution of plants and animals; and also how, by his interference with local conditions, and by his desired or undesirable introductions to the countries he has colonised, he has succeeded in upsetting the approximately stable equilibrium of faunas and floras which prevailed before his emergence from the savage state. But this wholesale disturbance of Nature's balance already entails retribution in the shape of much effort and expense in controlling the new conditions which his actions have brought about, if he is to escape penalties which, if ignored, are inevitable and dangerous.

To confine myself to one branch of the subject, to one class only of the animal kingdom, I propose, on the present occasion, to offer a summary of what the various civilised nations are attempting to do in the way of protecting themselves from evil results accruing from the wholesale disturbance of the conditions under which insect-faunas formerly locally attained

something like equilibrium for each country; and what national efforts have now become necessary in order to cope with the depredations of insects which have been unintentionally introduced, and which flourish amazingly under new conditions; or of indigenous insects which assert themselves in a menacing manner under profoundly altered natural conditions. In other words, I propose to discuss some of the great advances made in the study of insect-life, from an economic standpoint; or, as I may call it, the evolution of commercial entomology.

A brief glance at the damage caused by some of the insect pests that are being dealt with by the entomologist, will show what enormous losses occur every year, through their depredations. It has been the habit of American writers to make broad statements that the annual loss caused by insects in the United States or some other country is so many million dollars. I would take a few of our insect-pests in detail.

**White Ants** (*Termites*.) The damage caused to wood-work by white ants, in Australia, runs into many thousands of pounds annually, but it is nothing in comparison to what they do in countries where they attack crops. Dr. T. Bainbrigg Fletcher, writing to me from Bengal, India, last month, says, "With us they do a lot of damage to railway sleepers, buildings, etc., but this is insignificant compared with damage to crops, which may be put down at £40,000,000 annually for British India alone, at a conservative estimate. In many districts it is necessary to sow two or three times as a matter of ordinary routine, because the termites eat out the seed and young plants, and even after this take toll of  $\frac{1}{3}$  to  $\frac{1}{4}$  of the growing crop."

The white ants will be the most serious problem that the newly created Department of Agriculture in the Northern Territory of Australia will have to consider when planting their Experimental Farms.

**Cotton Boll Weevil** (*Anthonomus grandis*.) This small, brown beetle, that crossed over the Rio Grande into Texas in 1892, has revolutionised cotton-growing in the whole of the United States. Speaking in 1909, Professor Hunter said, "The cotton

boll weevil is now causing a damage in the United States, in each year, of at least 25,000,000 dollars (£5,000,000). The indications are that this amount will continue to be lost for some time on account of the difficulties in control, which will be encountered in the Mississippi valley." The millions of beetles deposit their eggs on the squares of the immature boll, the larvæ feeding in the tissue, causing each infested boll to drop off without producing a boll of cotton.

Grape-vine Louse (*Phylloxera vastatrix*).—This underground, root-destroying aphid was first discovered upon the vines in France, in 1863. Accidentally introduced with vines from North America, within ten years it had utterly destroyed 250,000 acres of vines. In 1896, it was estimated that this almost microscopic, yellow aphid had cost France £100,000,000, and had spread through the vineyards of the world in thirty-three years, reaching Australia in 1875. In the Bordeaux Trade Report for 1896, it was stated that, in the last thirteen years (1879-1892), the wine-production of France had decreased by 375,000,000 gallons. Signoret, in his essay upon this insect, said "The peasant of the Midi now pays eight sous for the wine he had previously bought for three sous."

Sugar-cane Beetle (*Lepidoderma albobirtum*).—The large, white grub of this lamellicorn beetle destroys the roots of the growing sugar-cane in the sugar-plantations of all Northern Queensland. The planters have formed a special beetle-fund, paying collectors from 6d. to 2s. per quart of beetles. In 1909, the beetles were so abundant and the price so good, that numbers of men working on the plantations threw up their work in the mills and canefields around Cairns, forming beetle-camps and collecting the beetles. In the 1908-1909 season, the Colonial Sugar Company paid away nearly £3,000, buying 31 tons of them, estimated to contain 16,000,000 beetles, all of which were taken on the six northern plantations.

Sugar-cane Weevil (*Sphenophorus obscurus*).—This beetle, though not a pest in Australia, is yet as serious a pest in the great sugar-cane plantations of Hawaii and Fiji as the other species is in Queensland. Unlike the latter, they deposit their

eggs in the stem of the cane, and both the larvæ and beetles feed upon it. At some of the Fijian plantations, up to 30 per cent. of the cane-crop has been damaged. At Sabasa, in 1908, three shillings per thousand were paid for 8,000,000 beetles.

*Fruit-Flies.*—Several species of the Family *Trypetidae* are causing enormous losses to the orchardists of the world. Two species in Australia (*Ceratitis capitata*, the introduced Mediterranean Fruit-fly, and our native, Queensland Fruit-fly, *Dacus Tryoni*) have cost orchardists many thousands of pounds, through their habit of depositing their eggs, by means of a needle-pointed ovipositor, in the ripening fruit. In Italy, the allied species, known as the Olive-fly (*Dacus oleæ*) was responsible for the loss of £1,000,000 worth of olive-oil in 1906, through the damage it caused to the ripening olives.

Three grain-weevils (*Calandra*) infest enormous quantities of stored grain in all parts of the world, but are naturally worst in the warmer climates, where thousands of bags of wheat and maize are rendered worthless by their presence.

In flour-mills, we have another cosmopolitan pest known under the name of the Mediterranean Flour-moth (*Ephestia kuehniella*) which lays her eggs amongst the dust and waste of the flour-mills, the larvæ getting into the shoots, elevators, etc., and webbing the flour together with silken strands, until it forms great felted masses, which interfere with the belts. This necessitates the stopping of the mills to open out and clear away all these felted masses, and means a large annual expenditure to every infested mill.

Yet these are only a few examples of the many insects that are always at work, and have to be dealt with by the entomologist.

The actual birthplace of economic entomology, as applied to agricultural and horticultural pursuits, is the United States of North America; while Canada, Australia, and South Africa have taken up the work on very similar lines. It can be easily understood that the great tracts now under cultivation, could not be worked at a profit under the conditions of farming in Great Britain and Europe. Large areas had to be put under crops, and both planted and harvested as cheaply as possible. The almost

individual attention of the farmer and gardener to his trees and fields in the old-world lands, was an intense cultivation that could not be profitably undertaken by the man in the new country. Therefore the new conditions gave plant-eating insects a much better chance to multiply, and they soon became a serious charge upon the crops.

It can be well understood, therefore, how the big farms and orchards became breeding grounds for injurious insects, which it was necessary to check. Though several of the American States had appointed State entomologists to do special work, such men as Dr. Harris, of Massachusetts, in 1831, Dr. Packard, in 1852, Dr. Asa Fitch, of the New York Agricultural Society, in 1854, it was not until 1854 that Mr. Townend Glover was appointed Federal Entomologist. It might, however, be claimed that the real foundation of the present Bureau of Entomology at Washington was the outcome of the appointment of the Entomological Commission, in 1877, by the Federal Government. This Commission was appointed to report upon the damage caused by the invasion of the immense swarms of Rocky Mountain locusts that started in 1873, and increased in such numbers and intensity, during the following three years, that no grass crops or even foliage of trees could be found over an area of 2,000,000 square miles, including some of the richest lands in the United States. Their report was voluminous but practical. The estimated damage caused by these locusts was 14,000,000 dollars: subscription lists were opened in all the towns of the United States to enable the ruined farmers to obtain seed for the next harvest. The three entomologists appointed were C. V. Riley, A. S. Packard, and Cyrus Thomas; Riley, from his work on this Commission, received the appointment of Federal Entomologist on Glover's retirement in the following year; and with Professor Comstock, the veteran chief of the Zoological Division of the Cornell University at the present time, laid the foundation of the Federal Bureau of Entomology as it now stands.

Riley had won his spurs as State Entomologist in Missouri, and, between 1868 and 1877, issued his famous annual reports, which are known to all economic workers. Dr. L. C. Howard,



who was Chief Assistant under Professor Riley, was appointed head of the Division when his chief resigned to take up the entomological work of the U. S. National Museum.

In an address given by Dr. Howard before the members of the Seventh International Zoological Conference at Boston, in 1907, he said, "At the present time the Entomological Division has been given Bureau rank, its Budget for the present year is 340,000 dollars (£68,000), and its pay roll includes 100 scientific assistants and 250 other employees."

Included in this small army, besides the regular staff in the offices of the Bureau at Washington, there are the staffs and field agents of the Experiment Stations scattered all over the States, in charge of well known entomologists. Other experiments are carried out in conjunction with the State Entomologists of the various State Agricultural Colleges and Experiment Stations, which State Agricultural Colleges came into existence in every State and Territory on the passing of the Hatch Act of 1888.

The literature issued by the Entomological Bureau in the form of Bulletins, Technical Series, Farmers' Circulars, and Monographs would form a small entomological library; and through them, the names of such investigators as Riley, Howard, Marlatt, Hopkins, Webster, Banks, Coquillet, Ashmead, and many others, have gained a world-wide reputation.

From July, 1888 to 1895, "Insect Life," vols. i-vii., was issued by the Federal Department, "devoted to the economy and life history of insects, especially in their relation to agriculture." This fine series contains special articles by the staff, bulletins, papers, and notes from all parts of the world. Its place is now taken by a series of monographs and papers issued in bulletin-form.

On November 12, 1889, the first annual meeting of the Association of Economic Entomologists was held at Washington; its membership was 49, at the present time it totals 329. The proceedings of the Association were published as bulletins of the U. S. Department until 1908, when the Associa-



tion took up the matter, and published the proceedings, as the *Journal of Economic Entomology*, upon a business basis, paying an annual subscription towards its publication.

In an address like this, it is impossible to enumerate even the many well-known writers in the United States, but a few might be mentioned, such as Prof. S. A. Forbes, of Urbana, Illinois, Prof. I. B. Smith, of New Jersey, Prof. W. D. Hunter, of Dallas, Texas; Prof. Comstock, and the late M. V. Slingerland, of Cornell University, Prof. C. W. Woodworth, of the University of California, Laurence Brunner, of Nebraska, Wilmon Newell, of Baton Rouge, and Albert Koebele, of California. It may be noticed that the most friendly relations exist between the different State Entomologists and the Federal officers; and in many of the State Experiment Colleges, they carry out investigations together, and special agents are often sent out, at the request of the State authorities for experts to help them in their work, such as Woglum's fumigation of citrus trees in California in 1908, and the Gypsy Moth Commission in Massachusetts.

The great agricultural interests of Canada make insect-pests an important question, though they have an advantage in fighting them, in the intense cold of their winters. The late Dr. James Fletcher, who held the dual position of Entomologist and Botanist to the Experiment Farms, from 1884 until his death in 1908, did a great deal to advance the status of economic work, and published many valuable reports. Dr. C. Gordon Hewett, his successor, has been appointed Dominion Entomologist, and has done some good work on house-flies and other pests.

In the Hawaiian Islands, there have been probably more entomologists employed at one time than in any other place of the same size in the world. There are three different staffs at work; those employed at the Federal Experiment Station; the officers of the Board of Agriculture and Forestry; and the officers of the Laboratories of the Sugar Planters' Association. Mr. David T. Fullaway is entomologist of the

Federal Station; Mr. E. M. Ehrhorn has succeeded the late Alexander Crow as chief of the Entomological Department of the Board of Commissioners; and Prof. Perkins holds a similar position at the Planters' Offices.

Most of the entomological work in South America has been in connection with the destructive locusts of the Argentine; and one of the most important reports published is by Prof. L. Brunner, in 1898, when he was commissioned by the merchants of Buenos Ayres to investigate the habits, and suggest methods of dealing with these pests. During the last two years Mr. C. H. T. Townsend has been engaged by the Chilian Government to investigate the insects damaging the cotton-plant.

After the annexation of the Philippine Islands by the United States, a Bureau of Science was founded, called the Bureau of Government Laboratories; its title was changed to the Bureau of Science in 1905. It has issued six volumes of its Journal, to which C. S. Banks has contributed some valuable reports upon the insect-pests of tropical plants.

In Cuba, at the Estacion Central Agronomica, there were two entomologists on the staff at Santiago de la Vegas, Dr. W. T. Horne and J. S. Houser, who have written on the insect-pests.

Australia has not been behindhand in regard to the advancement of Economic Entomology. Before any official Government Entomologists were appointed, Sir William Macleay had contributed some notes on insect-pests to the Proceedings of this Society; and Mr. Frazer S. Crawford, of Adelaide, had published valuable observations upon scale-insects and their parasites. Mr. W. M. Maskell, though working in Wellington, New Zealand, must be considered as one of our pioneers; for his papers upon scale-insects, in which the majority of the native coccidæ are described, were started during the seventies. The visits of Professors Koebele and Webster to Australia, from the United States, in 1880-81, and their search for the parasites of *Icerya purchasi*, the

Cottony Cushion Scale, aroused an interest in applied entomology, in Sydney in particular.

The creation of each of our Departments of Agriculture brought about the appointment of an Economic Entomologist, to study the habits and the methods of dealing with insect-pests. Victoria took the lead, and Mr. Charles French, who for some years had been assistant to Baron von Mueller, was our first official entomologist. He took office in the new department in 1889; and only retired last year, after 22 years' service. Though French has done little scientific descriptive work, he has issued, in five parts, a "Handbook of the Destructive Insects of Victoria," containing a popular account of introduced and indigenous insects, illustrated with many coloured plates. Though not a prolific writer, he has done a very great deal of work in popularising entomology, and other branches of natural history; and was one of the founders of the Field Naturalists' Club of Victoria, in 1882. Mr. Charles French, Junr., his eldest son, Assistant Entomologist for some years, has now been appointed to carry on the work.

In 1890, the Agricultural Department of New South Wales was formed, and Mr. A. Sidney Olliff, entomologist at the Australian Museum, was appointed entomologist on the agricultural staff; and the first paper, in the *Agricultural Gazette*, was one upon Codlin Moth, written by him. Mr. Olliff, though more a systematic than an economic entomologist, contributed a number of valuable reports and papers to the *Agricultural Gazette*, but after a protracted physical breakdown, died in the early part of 1896. On the regrading of the Service later in the year, I received the appointment, which I have had the honour to hold up to the present time. After a number of vicissitudes, and being located in very unsuitable buildings, and cramped for space, the Entomologist's Branch is now housed in very serviceable quarters in the Mining Museum, Lower George Street, with a modern insectorium in the Botanic Gardens, and an Experimental Station

at Narara. We have a fine, named, entomological collection for working purposes, particularly rich in Coccidæ, Hemiptera, Diptera, and Parasitic Hymenoptera. The staff consists of the Assistant Entomologist, Mr. W. B. Gurney, Assistant McCarthy, and a cadet; while we have the services of an artist in the Government Printing Office.

In Queensland, Mr. Henry Tryon, who, while Entomologist in the Brisbane Museum, had issued his first important contribution to the study of economic entomology in 1889, "Report on Insect and Fungus Pests" (Brisbane, 1889), was appointed to the Department of Agriculture in 1895, and has ever since carried on the duties of entomologist and plant-pathologist. He has now an assistant, Mr. E. Jarvis, who has charge of the collections. Most of Tryon's papers and reports have appeared in the official Journal, or in the Annual Reports of the Department. During the last few months, Mr. A. A. Girault, an American entomologist, has been appointed by the Queensland Government as a special investigator to deal with the beetle and other pests of the sugarcane.

Though South Australia has had a progressive Department of Agriculture for a good many years, there has never been an economic entomologist on the staff; but they have been very fortunate in having, in Mr. George Quinn, Chief Horticultural Inspector, a gentleman with a good working knowledge of insect-pests, and in the more practical way of advising people how to deal with them. Mr. J. G. O. Tepper, entomologist to the Adelaide Museum, has always been a consulting entomologist in reference to the identification of insect-pests

In 1896, Mr. Arthur M. Lea was appointed Entomologist to the Bureau of Agriculture at Perth, West Australia; he had previously been an assistant in the Entomological Branch in New South Wales, under Mr. Olliff. After holding office for several years, he accepted the position of Entomologist to the Bureau of Agriculture at Hobart, Tasmania, where he

remained until last year (1911), when he obtained the position of Entomologist to the Adelaide Museum, vacant owing to Mr. Tepper's retirement. So that, now, he virtually retires from the ranks of the economic workers.

In Western Australia, for some time after Lea's transfer to Tasmania, there was no entomologist, until Mr. George Compere appeared on the scene; and, under an arrangement with the Horticultural Board of California, by whom he was engaged as a collector, became attached to the West Australian Department of Agriculture, and worked conjointly for both places. He based all his work on the finding of parasites; and after travelling round the world several times, in search of effective parasites of most of our insect-pests, from which he claimed wonderful results, he retired from the field, and is now a fruit-inspector at San Francisco. Mr. Henry Newman is at present in charge of the entomological work in Perth.

In New Zealand, for many years Captain T. Broun was Port Officer and Entomologist to the Department of Agriculture, but most of his work, at any rate, latterly, was confined to inspection and quarantine work.

The Imperial Government, moving with the times, early in 1910, appointed an English entomologist, Mr. T. P. Jepson, as Entomologist to the Fiji Islands.

The Federal Government of Australia has also recently appointed an Indian entomologist from the Imperial Laboratories at Pusa, to take charge of the work in British New Guinea.

A conference of Government Entomologists was held in Sydney, in July, 1906, when representatives of South Australia, Tasmania, Victoria, New South Wales, and Queensland attended; New Zealand and Western Australia, though officially invited, could not participate. Among many important questions dealt with, was the enormous damage done by fruit-flies, and the methods to be adopted to deal with them. At the conclusion of this conference, a motion was put and

carried, that the Minister of Agriculture should be asked to send me to enquire into entomological matters in the United States. The matter was not dealt with until the meeting of the State Premiers in Brisbane, in June, 1907. It was decided that, with the permission of the New South Wales Government, I should investigate various entomological problems in America and Europe; India and Ceylon were afterwards added, at the request of Queensland. This was an important recognition of the importance of Economic Entomology by the Australian public. The report of my investigations was published as a bulletin, in 1909.

A Bill to establish an Australian Bureau of Agriculture was introduced into the House of Representatives in 1909, and read for the first time. Coming at the end of the session, it was shelved; and a change of Ministers, at the following elections, caused the Bill to be dropped. The scope and functions of the Bill would have led to the creation of a Department of Agriculture on very similar lines to that of the Federal Department of the United States. They were as follows: "(1) The acquisition and diffusion, among the people of the Commonwealth, of information connected with Agriculture and Forestry in all its branches. (2) The carrying out of experiments and investigations on pests or diseases affecting plants or live stock, and the means for preventing their spread or effecting their eradication. (4) The publication of reports and bulletins dealing with any matter of importance in regard to production in Australia. The publication of the reports of the experiments of experiment farms. Arrangements may be made with the Government of any State in respect to the following matters: Carrying out of experiments or investigation; supply and distribution of information; exchange and distribution of seeds and plants; any matter conducing to the development in Australia of the agricultural, pastoral, dairying, horticultural, and viticultural industries and forestry"

The Department of Agriculture in Washington, U.S.A., consists of a number of distinct divisions or branches, now



known as Bureaus, each under the direct control of the chief of division, responsible to the Secretary of Agriculture, the Hon. James Wilson, who ranks as a Cabinet Minister.

As in Washington, a Federal Bureau here would include an Economic Entomologist to cope with the many insect-pests that are common to all the States of the Commonwealth. This is one of the questions that will have to be considered by the Federal Government, as it has already formed an Agricultural Branch in the Northern Territory, with an Experiment Farm.

Speaking in 1910, Mr. W. Swinbourne (Minister of Agriculture for Victoria) said: "At present each of the States maintained a staff of experts to conduct research work. These experts included entomologists, vegetable pathologists, and veterinary officers, who were enquiring into many problems of vital interest to the producers of Australia. Were the Commonwealth to assume control of this work, much good could be done. Instead of half a dozen States working for the same ends along different lines, with expensive staffs, the Commonwealth would be able to co-ordinate the work, and secure for its advancement the very best scientific and practical experts that the world offered. With a staff consisting of some of the greatest living experts, the problems involving the States in losses aggregating hundreds of thousands of pounds annually, could be more effectively grappled with."

Among the questions affecting the whole of Australia, may be noted the following:—First the locust or grasshopper plague. These insects usually breed and multiply in the dry interior, and, under favourable climatic conditions, increase so rapidly, that they appear at irregular intervals in countless millions. They eat everything before them, and usually travel towards the coastal districts as they reach maturity. No one, unless he has passed through a real locust-invasion, can realise what it means. Until recent years, most of the damage they have done has been confined to grass-lands and the gardens of homesteads, and though individual loss is

often very great, it is not widespread, and has been borne without much comment, though often all the young green grass, that is looked forward to by the pastoralist for fattening his early lambs, may be cleared off just at the time of need.

The time is rapidly approaching when Australia will have to deal with the locust-question. As the farmer pushes out westward, the locust will be among his wheat-paddocks. The clearing away of large belts of timber and scrub have already made a difference, as they have an uninterrupted flight across the plains, where once they were turned aside. When this happens, drastic measures will have to be taken, and the united action of all the States brought against the locust-plague.

The Sheep Maggot-Flies are another universal pest of equal importance to sheep-breeders in all the Australian States, and of national importance. The remarkable acquired habit of a number of our indigenous blowflies, of blowing any soiled wool upon living healthy sheep, is spreading to all parts of Australia, and where we had only two species of flies at work a few years ago, we now find four or five species doing similar damage. It has been estimated, on good authority, that this new and increasing pest has cost the sheep-men of Australia nearly £1,000,000 annually, in loss of wool, sheep, and lambs, not including the increased expenditure in station-management in dressing the blown sheep.

The control of bot-flies, fowl-ticks, cattle-ticks, and other stock-pests universal in their range, is of equal importance to the people of all the States.

In our orchards, we have fruit-flies, codling moth, and half a dozen serious scale-insects of equal importance in many parts of Australia.

The question of uniform laws and regulations for dealing with plants, fruits, and other produce, and the pests that infest them is also a national question.

In Great Britain, a number of zoologists may be claimed as economic workers, though not exactly upon modern lines. Professor Westwood contributed many important papers, upon insects that were more or less pests, to the *Gardener's Chronicle*. John Curtis also worked on similar lines for many years, and first published the results of his observations in the *Journal of the Royal Agricultural Society of England*, between the years 1841-51; also in book-form, in 1859, while a second edition, entitled "Farm Insects," was brought out in 1883. But the worker entitled to be regarded as the pioneer in modern economic entomology in Great Britain, is Miss Eleanor A. Ormerod, who, starting in 1876, published an "Annual Report of Observations on Injurious Insects, and Common Farm Pests" until 1900. These bulletins were printed, and distributed by her, at her own expense, to every naturalist in any part of the world, whom she knew to be interested in this work. They are beautifully illustrated by her sister, with many plates and figures; and, among general notes, contain many monographs that are masterpieces of work in economic entomology. As might be imagined, such a public-spirited woman held many honorary titles, and was Consulting Entomologist to the Royal Agricultural Society of England.

In 1886, Mr. Charles Whitehead was appointed as adviser on insect-pests to the Council of Agriculture, and later on, when the Board of Agriculture was formed, he became its official authority, but his chief work has been the compilation of entomological leaflets, for distribution among the agriculturists of Great Britain.

Reports by Mr. Walter F. H. Blandford, upon insect-pests, have also been issued in the *Kew Bulletins*. These deal with the pests of the different British Possessions, such as "The Palm-Weevil in Honduras," 1893; and "Insects Destructive to Plants in West Africa," 1897; this work has been generally carried out at the request of the Colonial Office.

Mr. F. V. Theobald has been an active worker in applied entomology, and has issued yearly reports, since 1902, upon insect-pests, for the South-Eastern Agricultural College at Wye. In 1903, the British Museum sent out its "First Report upon Economic Zoology," prepared by Theobald; which was followed by the Second Report for 1903, in which a great deal of information on insect-pests is included. The special grant for this useful work was, however, not continued, so that no further British Museum Reports were published, under this heading.

In the light of Medical Entomology, we must also include Theobald's great work on the Culicidæ of the world, five volumes of letterpress and one of plates (1901-1910), issued by the Trustees of the British Museum.

Prof. Robert Newstead, who has recently had the well-deserved honour of being appointed first Professor of Entomology (Liverpool University) in Great Britain, is well known in the field of economic science, both by his earlier work on scale-insects, and latterly, in connection with the Liverpool Tropical School of Medicine. According to "Nature" (October 11th, 1911) he is to accompany Colonel Sir David Bruce to Nyassaland early this year, on an expedition sent out under the auspices of the Royal Society, to study the relation between flies and big game in that country, where forty cases of sleeping sickness have appeared since 1909.

Mr. Walter E. Collinge, of Birmingham, has been active in the study of economic zoology, and has issued five "Reports upon Injurious Insects and other Animals" (1904-1908), and "Economic Biology" (1st, 1911; 2nd, 1912). In conjunction with Messrs. Nuttal, Warburton, and Cooper, he has done some good work upon the ticks (*Argasidæ* and *Ixodidæ*).

For the last ten years, Professor G. H. Carpenter has published papers upon injurious insects in the Economic Proceedings of the Royal Dublin Society, dealing specially with those infesting domestic animals. Dr. R. Stewart McDougall (Consulting Entomologist to the Highland and Agricultural Society

of Scotland), frequently contributes papers and reports upon all kinds of insect-pests of importance in Scotland.

With the establishment of the Imperial Department of Agriculture for the West Indies, under the directorship of Sir Daniel Morris, in 1898, an entomologist was appointed to study the different insect-pests of the West Indies. Mr. H. Maxwell Lefroy took up the work in the following year, and issued a list of the scale-insects before he resigned, to take a position under the Indian Government. His place was filled by Mr. H. A. Ballou, who is still the authority on insect-pests of the West Indies, where I met him, in Barbadoes, at the Imperial Conference of Agriculture, in 1908.

Last year, the First International Congress of Entomologists met at Brussels, and held a seven days' session, dealing with both systematic and economic entomological questions. This gathering comprised representatives from all parts of the world, and shows how the study of entomology is advancing. The first report, just to hand, contains over 500 pages, and many illustrations, with forty papers contributed in English, French, German, Spanish, and Italian. In August of this year, a second meeting will be held at Oxford University.

In June, 1909, Lord Crewe, then Secretary of State for the Colonies, appointed the Entomological Research Committee (Tropical Africa). It consists of twenty of the leading British zoologists, doctors, and entomologists, who have been connected with the study of the insect-plagues of tropical countries. It is under the chairmanship of Lord Cromer. The original idea was to deal with the insects, and particularly, suspected disease-carrying insects, of the colonies, British possessions, and protectorates in Tropical Africa; and collectors were equipped, and sent out to obtain specimens, and co-operate with the officers resident in these possessions. It was afterwards found that the scope of the work could be greatly enlarged if operations were extended beyond Africa. An opportunity was taken advantage of by Lord Cromer, when the leading men from all the dominions of the British



Empire were assembled in London, at the Coronation of King George V. He convened a meeting of the members of the Entomological Research Committee, and invited the statesmen from abroad, when he explained the work proposed, and asked for financial aid from the Australian States, the Dominion of Canada, and the South African States. Among the gentlemen who spoke at this meeting, was the Premier of New South Wales, the Hon. J. McGowen. At the Premiers' Conference held in Melbourne last January, it was agreed that the Australian States should contribute £200 to the funds of the Research Committee.

In Europe, it cannot be said that there has been much experimental economic entomology carried out. Prof. Paul Marchal, attached to the Agricultural Department in Paris, is well known as an economic worker, and is Professor of Zoology to the students of the Agronomical Institute. The late Professor Valery Mayet was lecturer on economic entomology at the National Agricultural School at Montpellier; and I spent several very interesting days with both these gentlemen. In Spain, as in France, there are many important problems in agricultural entomology requiring solution; and, at the time of my visit to Madrid, Professor Navarro, who is in charge of the experimental work at the School of Agriculture, said that they expected to get a law through that year (1908), to deal with insect- and fungus-pests.

The Italian Government has always taken a keen interest in methods of dealing with insect-pests, such as the scale-insects that damage the mulberry trees, others on the citrus-crops, and that great pest of the olive-grower, the olive-fly (*Dacus oleæ*). There is a fine entomological station at Portici, near Naples, under the charge of Dr. Filippo Silvestri, who has several other well-known entomologists associated with him, Dr. G. Leonardi being his chief assistant. Their quarters are an old palace, and on the flat roof on the top of the building, they have a regular insectarium. Florence, however, is the headquarters of the economic entomolo-



gists. Professor A. Berlese is director of the Royal Station for Agricultural Entomology, with Professor del Guercio, and Drs. Ribaga and Paoli. They are greatly interested in the work of checking the ravages of the olive-fly; and, while Dr. Silvestri considers that parasites could be introduced to control this pest, and he recently visited the United States and Hawaii to study their parasites, Prof. Berlese thinks that such mechanical methods as poisoning the flies, and destroying all waste, will end the trouble. I missed Berlese in Florence, but made a special visit to Genoa, where he was making some experiments.

Hungary is well up to date in economic work. Dr. Geza Horvath was originally in charge of the Royal Entomological Station at Budapest; but, at the time of my visit, he was Director of the Royal Museum of Natural History, and Professor Josef Jablonowski was in charge, and might be styled the Government Entomologist of Hungary. The Viticultural Station is on the outskirts of Pesth; but they have fine laboratories, and collections of entomological specimens. One of the drawbacks to the value of this station, from our point of view, is that most of its reports are issued in the Hungarian language.

Forestry and forest-pests are important in Hungary, as they are in Germany, and, in the latter country, most of the economic work is done in connection with the destruction of timber-destroying insects.

In Russia, all branches of economic work are studied; and there are a number of active workers scattered over this great empire. Professor Portschinsky has charge of most of the stations under the Department of Agriculture. Scientific methods of pruning and spraying are carried out in their orchards, and several of the professors are members of the Association of Economic Entomologists.

In Finland, my valued correspondent, Professor Enzo Reuter, has a well equipped entomological branch at the University of Helsingfors, while right from the other side of

Russia, last month, I received a letter from Dr. Platnivow, at Taskent, in Russian Turkestan, asking me for literature and reports, and informing me that he was organising an Entomological Station in that part of the world.

Nothing much is done in the East, under Turkish rule, but everyone has heard something about the accomplishments of the British officials in Cyprus, in locust-destruction, but it is not generally known that there is an Act in force and a locust-tax. Everybody, including the British officials, pays a percentage of his income or salary to the fund for locust-extermination.

Japan has moved along in scientific agriculture, as in other works; and I have a number of correspondents in that country. At the Imperial Central Agricultural Experiment Station at Tokyo, Dr. Kuwana is studying the Coccidæ of Japan. Professor Matsumura, of the Sappora Agricultural College, Hokkaida, is working at the small homoptera, and the damage they do to the rice-crops. Dr. S. Onuki and Professor C. Sasaki, of the Imperial College, at Tokyo, have also worked at entomology on economic lines.

The African States and Colonies, like other countries occupied in developing their agricultural resources, have realised the necessity of having scientific branches of their Departments of Agriculture. The Government of Cape Colony appointed Mr. Charles P. Lounsbury Government Entomologist, in 1895; which post he held until last year, when he was promoted to the premier position of Chief of the Division of Entomology, Union of South Africa. His investigations of South African ticks, and other economic work are well and widely known. Dr. Dreyer has succeeded him. Mr. Claude Fuller, once an officer in the New South Wales Department, was first appointed assistant to Mr. Lounsbury, but later on left Cape Colony to take the position of Entomologist to the Natal Government, which he still holds. On the reorganisation, after the South African war, a Department of Agriculture was formed in the Transvaal, when Mr. C. B. Simpson,

of Washington, was appointed entomologist, and was one of the first men to take up the work against the locusts. His untimely death, from typhoid fever, in 1906, was a great loss to economic entomology in Africa. His assistant, Mr. C. W. Howard, was appointed to the position, but resigned shortly afterwards, and went to Lourenzo Marquez, where he has been doing some good work in connection with the Locust Bureau for Mozambique. At Uganda, the authorities have an entomologist, Mr. C. C. Gowdey, stationed at Entebbe, who has issued some reports upon cotton-insects. At Cairo, Mr. F. C. Willocks is Entomologist to the Khedivial Agricultural Society, and has published some fine papers upon insects injurious to the cotton-plant in Egypt. In the Soudan, Mr. H. H. King, is Entomologist to the Staff of the Gordon Memorial College at Khartoum, and has worked on the mosquitoes and biting flies of that region.

At the present time, the Entomological Research Committee has two trained entomologists travelling through the different British Possessions and Protectorates, and enlisting the services of the officers in collecting all kinds of insects for the British Museum.

The conditions of agriculture and forestry in India and the East generally, make it difficult for scientific investigators or teachers to make much headway in the checking or destruction of insect-pests. It is only within the last few years that any steps have been taken to study Indian insects from an economic standpoint. In 1903, Mr. H. Maxwell Lefroy was appointed Imperial Entomologist to the Government of India, and the Imperial Research Laboratories were started at Pusa, Upper Bengal, with a staff of scientific experts at this experimental station. At the time of my visit (1908), the new buildings were just finished; these are fitted with electric light, and all modern equipment. Mr. Maxwell Lefroy had a staff consisting of Mr. Howlett, another young Englishman, and a number of native assistants, artists and collectors. Since then, Messrs. Lefroy and Howlett have

published their fine work on Indian insects. Dr. Bainbrigg Fletcher is in charge, while Mr. Lefroy is in England on leave, working for the Entomological Research Committee.

The various provinces into which India is divided, have their own Provincial Departments of Agriculture; and, on most of the staffs, there is a trained native entomologist, generally called "Assistant to the Botanist," or "Experimentalist." Several of these men, whom I met, knew a great deal about the local insect-pests of their province. Other men who are identified with economic entomology in India, are Mr. E. P. Stebbing, Forest Entomologist to the Indian Government, who is stationed at Derha Don, and has published several reports upon forest-insects; and Mr. E. C. Cotes, who, for some years, edited "Indian Museum Notes," containing many contributions to economic entomology.

Turning to Ceylon, Mr. E. E. Green, Government Entomologist, is well known to all workers on Coccidæ. He has his laboratories at the Royal Botanic Gardens at Peradenyia. He has been engaged, in his leisure time, for some years, upon his great work "The Coccidæ of Ceylon," of which four parts have already appeared.

The countries producing quantities of fruit, vegetables, and field-crops, have always been the foremost in protecting their agricultural interests, and in taking measures to deal with insect-pests. During the last thirty years, many Insect-Pest Bills, Vegetation-Diseases Acts, and Horticultural Regulations have been passed, and become law.

In most cases, all the earlier Acts have been Quarantine Laws, enacted to deal with some special pest; but latterly, they have been framed to regulate the working of orchards within the States. In a general way, the United States have not passed many laws dealing with the import of produce that might contain pests; but many of the individual States have made State regulations to deal with special pests, such as the San José Scale in Maryland; or the inspection of orchards

under the State Crop Pest Commission of Louisiana. The California State Commission of Horticulture, which was created in 1883, under the title of the State Board of Horticulture, divided California into seven districts, each under a Commission, with a President or Chief Commissioner over the whole. The powers vested in these Commissioners are very great, and at different times they have carried out some drastic measures in the way of destroying orchards, and stopping fruit and plants from entering the State. In the Territory of Hawaii, very similar regulations have been enacted, and a board has been appointed, known as the Board of Agriculture and Forestry, under which strict quarantine regulations are enforced against plants, fruit, rice, etc.

South Africa had an Act in force in 1876, to which was added the Vineyards Protection Act of 1886. A proclamation was issued by the Governor of the Cape of Good Hope, in 1903, dealing with Import Regulations, in which many plants and trees were absolutely prohibited.

The South African Central Locust-Bureau was formed by the joint action of the Governments of several British Colonies and Territories of South Africa in 1906, to take united action against the plague-locusts, that are a general pest to the whole of the States and Colonies. This confederation now comprises eleven States, including Mozambique and German South-West Africa, which are equally interested in locust-destruction; it is one of the most important organisations in the world, dealing with insect-pests.

In Great Britain, only two enactments dealing with insect-pests exclusively have been passed. The first, an Act for preventing the introduction and spreading of insects destructive to crops, known as the Destructive Insects Act, 1877, was brought into force to deal, if necessary, with the Colorado beetle, and prevent its importation from America. The second was entitled "Destructive Insects and Pests Act, 1907," and includes insects, fungi and other pests. This Act is both a quarantine Act, and also regulates the distribu-

tion of suspected plants and fruits in the different districts. Through the scare raised, some ten years ago, in Europe, over the danger of introducing San José Scale (*Aspidiotus perniciosus*) into their orchards from the United States, the German Government passed a law against the admission of infested or diseased fruit.

It is hardly necessary to enter into a detailed account of the various laws in force among the European nations, most of which have been passed to deal with Phylloxera, which, in spite of all the laws and regulations, has spread all over the world.

A great deal of interesting information can be gained by a study of the Vegetation Diseases Acts and subsequent regulations in force in the Australian States and New Zealand. The first Act dealing with insect-pests, that came into force in Tasmania, was the Codlin Moth Act of 1887. It was repealed the following year, and replaced by "an Act to make better provision for the Destruction of the Codlin Moth, October, 1888." This Act, afterwards cited as the "Codlin Moth Act, 1888," was a comprehensive one, in which Tasmania was divided into thirty fruit-districts, each of which was under the charge of a Fruit Board, the members of which were fruit-growers, elected by the fruit-growers of the district. They received no remuneration, but appointed paid Fruit Inspectors. A tax of four shillings per acre was levied on all orchards, to raise funds to pay the inspectors' salaries and other expenses.

In 1891, the Codlin Moth Amendment Act came into force, and the new regulations, which did not alter the old Act, but chiefly the method of the election of the Boards, were issued in June, 1892. The Chief Inspector of Stock was invested with powers to enforce the provisions of the Act. In 1900, another Act to amend the Codlin Moth Act of 1888, came into force ("Codlin Moth Amendment Act, 1900"), but again simply dealt with the election of the officers of the Boards.



In 1898, most of the Agricultural Departments of our States and New Zealand (except South Australia, which had already had such an Act in force for many years), were awakening to the fact that it was advisable to stop, by import regulations, the further spread of insect and fungus-pests that had not yet reached them, or were confined to restricted areas. The Tasmanian authorities passed "An Act to prevent the introduction into Tasmania of diseases, insect, fungus, and other pests affecting Vegetation, October, 1898." This was chiefly passed on account of the scare raised on the mainland by the spread of the Queensland fruit-fly (*Dacus tryoni*) and the San José Scale (*Aspidiotus perniciosus*). Therefore Tasmania has two distinct Acts in force; the internal one dealing with the orchards administered by the local Fruit-Boards; and an Import or Port Act dealing with the import and export of fruit, administered by the inspectors of the Department of Agriculture. Just as the Tasmanian authorities had to take action against their chief enemy, the Codling Moth, the Victorians were called upon to take active measures, owing to the outbreak of Phylloxera in the Geelong vineyards, in 1875. The Diseases of Vines Act, 1877 provided for the appointment of inspectors, and the methods to be adopted to fight this pest; but it was virtually repealed by the Amending Act, which was passed in the following year.

The Vegetation Diseases Act, 1896, dealt with the importation of pests from abroad; and also with the examination or inspection of all the orchards in the State; and, under the regulations, a great number of insects and fungi were proclaimed pests. The scope of this Act was much enlarged by the Vegetation Diseases Act, 1901, and the subsequent regulations.

After several Fruit-Growers' Conferences, the Victorian Fruit Case Act came into force, in 1906, under which a uniform size and shape for all cases containing fruit, was compulsory.

In New South Wales, like Victoria, it was the advent of Phylloxera that started legislation against fruit-pests; and, in 1886, the Vine Diseases Act was passed, followed, in 1888, by the "Vine Diseases Act, Amendment Act." In June, 1893, there came into force "An Act relating to Vine Diseases, to prevent the introduction into this Colony, or removal from place to place in this Colony, of diseased grape-vines, and to eradicate a certain disease affecting grapes, grape-vines or vineyards, to proclaim Vine Districts; to appoint Boards; to make assessments and levy rates; and for other purposes incidental thereto. Three vine-districts were created, The Cumberland, The Murray River, and The Hunter River Vine District.

In 1897, the New South Wales Government brought an Act into force, entitled "An Act for the better prevention of the spread of diseases, and for the destruction of insects, fungi, and other pests injuriously affecting any kind of vegetation, and to prevent the introduction of those diseases and insects into the Colony, 10th December, 1897." This Act was framed, not only to act as a check on the importation of pests from abroad, but to deal with them in the orchards of the Colony; but it was so amended, on passing the House, that it resolved itself into simply a Port Act, and the inspection of all fruit coming into New South Wales.

The next Act, on very similar lines, was the "Vine and Vegetation Diseases Act, 1901," which consolidated the Vine Diseases Act and the Vegetation Diseases Act of 1907, but did not give any power to the officers of the Department of Agriculture to enter any orchard without the invitation of the occupier.

Through the ravages of the Mediterranean and Queensland fruit-flies, and the constant friction with the other States (1904-6), where inspection of orchards was enforced in a more or less efficient manner, the Government, after considerable opposition, in which the list of pests to be dealt with was reduced to two, passed the "Vine and Vegetation

Diseases (Fruit Pests) Act, 1906." It is construed with Parts iii. and iv. of the "Vine and Vegetation Diseases Act, 1901, hereinafter referred to as the Principal Act." Fruit-Pest means the Codling Moth (*Carpocapsa pomonella*), any species of fruit-fly (*Tephritidæ*), and includes any such fruit-pest, in whatever stage of existence it may be."

This Act was not assented to until the 18th December; but early in the following year (1907), a number of fruit-inspectors were appointed, and the work of destroying all infested fruit was taken in hand.

Queensland has never become infested with Phylloxera, so that no Vine Diseases Acts have been necessary; and there were no regulations in that State until the end of 1896, when 'An Act to prevent the Introduction and provide for the Eradication of Diseases affecting Vegetation, and for other purposes,' came into force. This comprehensive Act is the one still in force under the regulations which were issued in June 23rd, 1911, and superseded all the previous regulations issued under the provisions of the Act. This Act deals with the export and import of fruit, as well as the inspection of orchards, and the destruction of diseased fruit, together with the registration of all plant-nurseries.

In Western Australia, "The Insect Pests Amendment Act" was passed in 1898. It was entitled "An Act to prevent the introduction into Western Australia of Diseases affecting Orchards and Gardens, and to provide for the eradication of such Diseases and to prevent the spread thereof." This Act repealed two other Acts, namely, "The Destructive Insects and Substances Act of 1880," and the "Insect Pests Act of 1894." This Act gives fruit-inspectors all the powers that they have in the other States, even to quarantining an orchard in which a scheduled disease has been recorded; and every occupier of an orchard, in which a disease appears, is required to give notice to the Secretary of Agriculture in Perth, within twenty-four hours. Amended regulations were

issued on 5th June, 1907, to carry out the provisions of the Act.

In South Australia, the first Act came into force in 1874, "The Vines Protection Act," to protect the State against the introduction of Phylloxera; but it was annulled, in 1878, by another entitled "An Act for the Prevention and Eradication of Diseases in Vines." In 1885, the Government passed "An Act to prevent the introduction, and to provide for the Destruction of certain Insects, and the Eradication of Diseases which injuriously affect Vegetation." The Act incorporated the earlier one, and, while still dealing with the vine Phylloxera, added, under the definition of Insect, the Codlin Moth, Red Scale of Orange, and the Colorado beetle. This Act was known as "The Vine, Fruit, and Vegetable Protection Act, 1885." It was the first general Act that was passed in Australasia. The operations of the Act, in respect to the control of every parcel of plants, and fruits coming into the State, has been in force for about fifteen years; and South Australia is one of the cleanest States, as regards all fruit-pests, because she saw the danger of their introduction many years before the other States passed Vegetation Diseases Acts. Under proclamations and regulations, this Act was made more effective, and other pests were added to the lists of insects. To bring it more into line with the other States, an Act to amend "The Vine, Fruit, and Vegetable Protection Act, 1885, and for other purposes," was passed on November 23rd, 1910. It incorporated, but did not repeal, the earlier Act, so that all the regulations are worked under a combined quarantine and orchard Act.

The Phylloxera Board consists of ratepayers and two Government nominees; and, under a recent clause, empowers this Board to destroy neglected vineyards at the expense of the owners.

There have been a number of Acts in force in New Zealand, and there is a very stringent regulation against the importation of grapes and vines from all Phylloxera-infested

countries. "The Orchard and Garden Pests Act of 1903," has been consolidated by an Act bearing the same title, passed in 1908, under which the quarantine and orchard inspection regulations are enforced by inspectors.

Australia, besides these State Acts, has also among the Provisional Regulations of the Quarantine Act (1908) of the Commonwealth of Australia, the following regulation, that can be enforced against imported insect-pests. "Any imported goods found to be infested with a noxious insect or pest, or fungus may, if in the opinion of the Chief Quarantine Officer such goods can be treated so as to destroy such insect pest, or fungus without the destruction or denaturation of the goods, be landed in quarantine, and treated under the supervision of a quarantine officer at a quarantine station."

In the Dominion of Canada, certain of the Provincial Governments have instituted legislative measures in reference to plant-diseases and pests. In British Columbia, all plants and fruit entering the provinces are inspected, and those found to be infested are treated or condemned. In Ontario, the Act deals with the inspection of plant-nurseries, and the treatment of plants grown therein. Nova Scotia recently brought an Act into force to enable the Department of Agriculture to inspect orchards, and to control or deal with the more serious pests and plant-diseases. In 1910, the Federal Government of Canada passed an Act to deal with pests, entitled "An Act to prevent the Introduction or spreading of Insects, Pests, and Diseases destructive to Vegetation," to be cited as "The Destructive Insect and Pest Act" under the charge of the Minister of Agriculture. This Act deals with all vegetable or other matter introduced into Canada, at six specified ports of entry, where fumigation stations are established; and inspectors under the Act can enter any place where plants are growing. Under the Regulations issued under this Act, early in 1911, ten of the most important insects and fungi are listed, and the Regulations made under the "San José Scale Act" are repealed.



In Bermuda, in consequence of the damage done to the orchards by the advent of the Mediterranean Fruit-fly (*Ceratitis capitata*), "The Fruit-fly Destruction Act" was passed in 1907. Under this Act, Fruit-Inspectors were appointed to see that all infested fruit and windfalls were collected and destroyed. The results, judging from the latest reports, are very satisfactory. A number of regulations have been made on the advice of the Imperial Department of Agriculture in the West Indies, to deal chiefly with the importation of seeds, plants, and cuttings. The first of these came into force between 1883 and 1898, to prevent the introduction of the dread coffee-leaf disease (*Hemileia*). The more recent regulations allow the importations, but enforce the fumigation or treatment of all such imported seeds or plants.

It will be seen that most of these laws and regulations have been called into operation by the appearance of some noxious insect. All will agree that every precaution should be taken to protect the producers. When, however, two neighbouring States are infested in common with identical pests, it does seem something of an anomaly to pass regulations and condemn each other's fruit at the port of entry, and to return it without any alternative curative treatment, as was the method in vogue only a few years ago. Now, in most cases, sorting, fumigation, or dipping and repacking are allowed to most condemned fruit, plants, and cuttings after condemnation by our inspectors. This concession is a great advantage to trade, and to the public generally.

Total prohibition of plants or fruit has been, at times, enforced by one State against another. Take, for example, the action of the New Zealand authorities against the importation of grapes from New South Wales. It led to many protests from our growers; but any State would be wise to insist upon the total prohibition of such a destructive pest as *Phylloxera*, however slight the danger might be of introducing it with grapes.



It has been open to doubt whether some of our interstate regulations were not retaliatory, or passed in the interest of the growers in one State against the importing ones; but, by means of conferences consisting of the interstate producers, inspectors, and Cabinet Ministers, this feeling has passed, and our import and export laws are now working harmoniously.

On looking back we can only wish that the disastrous results of the casual introduction of insects, birds, rabbits, prickly pear, and noxious weeds had been recognised, and action taken even twenty-five years ago; vast sums could then have been saved to the whole of Australia.

The good results obtained from the administration of the internal laws of this State, in the compulsory inspection of orchards, have been very striking. In the first instance, it has led to the destruction of an enormous number of worthless, neglected fruit-trees that were always a breeding-ground for pests, and a menace to the commercial orchards. The owners have found it much simpler to cut down and burn them, than to clean and bandage, as they are otherwise compelled to do by the regulations of the Vegetation Diseases Act. The compulsory collection and destruction of all wind-falls, damaged and infected fruit has reduced the ravages of the fruit-flies to a minimum, and made a marked difference in the number of codling moth grubs; while it has proved to the orchardists collectively, the value of these methods, to which many of them were opposed.

We have learned many things in the study of economic entomology in regard to the relation of plant and insect life. We have proved that if plants are well fed, planted in suitable well-drained land, and the soil around them well cultivated to retain the surface-moisture, they are very much better fitted to resist insect-attacks than trees in which these conditions have been neglected.

With the improved modern methods of spraying, we can satisfactorily destroy many of the worst insect-pests. In the

study of the chemical combination of the materials used for particular sprays, for the different groups of insects, we have made them more effective as contact or stomach poisons. For example, in arsenical poisons, Paris Green was first used to destroy codling moth; it was found that arsenite of soda was, in many cases, a cheaper and better spray than Paris Green; now, in arsenate of lead, we have a much more perfect and longer lasting spray than both our former chemicals. Fumigation with hydrocyanic acid gas is another very efficient agent in destroying many injurious insects, that suck up the sap, and stick to the bark and foliage. In one application, every scale and aphid on a citrus tree can be destroyed; whereas the difficulty in the spraying of all evergreen trees is to wet all parts, and also the trees frequently require several such applications.

Fumigation is also being largely adopted in the destruction of household pests, such as bugs, cockroaches, etc., the penetrating power of this volatile gas finding its way into the most minute cracks or crevices, and in about four hours will kill all these insects in every stage of development. It is also being used in the same way in ships for fumigating the cabins; and the flour-millers are finding it very effective in destroying the Mediterranean flour-moth.

The entomologist has many important problems to deal with at the present time in the study of insect-pests; but experience has taught him that when it has been carefully studied, there is not one that cannot be checked and reduced, until it becomes of no commercial importance. He has reached the proud position, that he is consulted by all sorts and conditions of men; the orchardist from the Hawkesbury River flats, the squatter from "beyond the rainless Barwon," the sugar-planter from the tropical scrubs, the coconut and rubber-planter in the Pacific Islands, the farmer from the Riverina, all come to him. In the city, the merchant, the doctor, the seedsman, the architect, and housewife seek his

assistance. His bulletins and reports are circulating all over the world, and questions and answers are passed to and from all quarters of the globe during the course of the year.

Mr. J. H. Campbell, Hon. Treasurer, presented the balance sheet for the year 1911, duly signed by the Auditor, Mr. F. H. Rayment, F.C.P.A., Incorporated Accountant; and he moved that it be received and adopted, which was carried unanimously. For the year ended 31st December, 1911, the income of the General Account from all sources was £1,027 2s. 4d., and the expenditure £849 15s., leaving a credit balance of £139 3s. 1d. to carry forward, after providing for a debit balance of £16 3s. 3d. from the previous year, and transferring £22 1s. to the Book-binding Account. The Bacteriology Account returned an income of £509 17s. 4d.; the expenditure was £503 19s. 11d., £24 was invested, and a credit balance of £71 1s. 3d. carried forward. The income of the Linnean Macleay Fellowships Account was £1,542 9s. 11d., of which £466 18s. 4d. was expended, and the balance of £1,074 1s. 7d. transferred to Capital.

After a ballot had been taken to fill vacancies in the Council, the President declared the following elections for the current Session to have been duly made :—

PRESIDENT : W. W. Froggatt, F.L.S.

MEMBERS OF COUNCIL : R. T. Baker, F.L.S., C. Hedley, F.L.S., A. H. S. Lucas, M.A., B.Sc., T. Steel, F.L.S., and G. A. Waterhouse, B.Sc., B.E.

AUDITOR : F. H. Rayment, F.C.P.A.

On the motion of Professor David, seconded by Mr. Fred Turner, and supported by Mr. R. T. Baker, it was resolved that a letter conveying a record of the Society's appreciation of Sir Joseph Hooker's eminent services to botanical science, and especially of his important contribution to a knowledge of the flora of Tasmania and Australia, should be forwarded to Lady Hooker, together with an expression of sincere sympathy.

On the motion of Mr. Tillyard, seconded by Mr. Waterhouse, a very cordial vote of thanks was accorded to the retiring President, by acclamation.